

## DESCRIPTION

Demonstration circuit 1349A is a high current polyphase 3-output step-down supply with tracking featuring the LTC3853EUJ. The entire circuit, excluding the bulk output capacitors, fits within a 1.5" X 1.5" area on all layers. The package style for the LTC3850EUJ is a 6mm x 6mm plastic QFN.

The main features of the board include rail tracking, an internal 5V linear regulator for bias, RUN pins for each output, two PGOOD signals and a Mode selector that allow the converter to run in CCM, pulse skip or Burst Mode operation. Synchronization to an external clock is also possible through some minor component changes.

The board is configured for resistor current sensing, but optional DCR sensing is possible through some component changes.

The input voltage range is 6.5V to 14V, but for applications with narrow,  $5V \pm 0.5V$  input range, the board has an optional resistor to tie the INTVCC pin to the VIN pin.

The LT3853 datasheet gives a complete description of the part, operation and application information and must be read in conjunction with this quick start guide for demo circuit 1349A.

**Design files for this circuit board are available. Call the LTC factory.**

Burst Mode is a trademark of Linear Technology Corporation

**Table 1. Performance Summary ( $T_A = 25^\circ\text{C}$ )**

PARAMETER	CONDITION	VALUE
Input Voltage Range		6.5V - 14V
Output Voltage $V_{OUT1}$	$V_{IN} = 6.5V$ to 14V, $I_{OUT1} = 0A$ to 15A	1.8V $\pm 2\%$
Output Voltage $V_{OUT2}$	$V_{IN} = 6.5V$ to 14V, $I_{OUT2} = 0A$ to 15A	1.2V $\pm 2\%$
Output Voltage $V_{OUT3}$	$V_{IN} = 6.5V$ to 14V, $I_{OUT3} = 0A$ to 15A	2.5V $\pm 2\%$
Nominal Switching Frequency		400kHz
Efficiency See Figures 4, 5 and 6 for efficiency curves	$V_{OUT1} = 1.8V$ , $I_{OUT1} = 15A$ ; $V_{IN} = 12V$	89.2% Typical
	$V_{OUT2} = 1.2V$ , $I_{OUT2} = 15A$ ; $V_{IN} = 12V$	86.6% Typical
	$V_{OUT3} = 2.5V$ , $I_{OUT3} = 15A$ ; $V_{IN} = 12V$	91.7% Typical

## QUICK START PROCEDURE

Demonstration circuit 1349A is easy to set up to evaluate the performance of the LTC3853EUJ. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

**NOTE:** When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across the Vin or Vout and GND terminals. See Figure 2 for proper scope probe technique.

- Place jumpers in the following positions:
  - JP1**    On
  - JP2**    On
  - JP3**    On
  - JP4**    Forced Continuous
- With power off, connect the input power supply to Vin and GND.
- Turn on the power at the input.

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## HIGH CURRENT POLYPHASE 3-OUTPUT STEP-DOWN SUPPLY WITH TRACKING

**NOTE:** Make sure that the input voltage does not exceed 14V.

4. Check for the proper output voltages.

Vout1 = 1.765V to 1.836V,

Vout2 = 1.176V to 1.224V,

Vout3 = 2.450V to 2.550V

**NOTE:** If there is no output, temporarily disconnect the load to make sure that the load is not set too high.

5. Once the proper output voltages are established, adjust the loads within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other parameters.

6. Different operating modes can be evaluated by changing the position of jumper JP4.

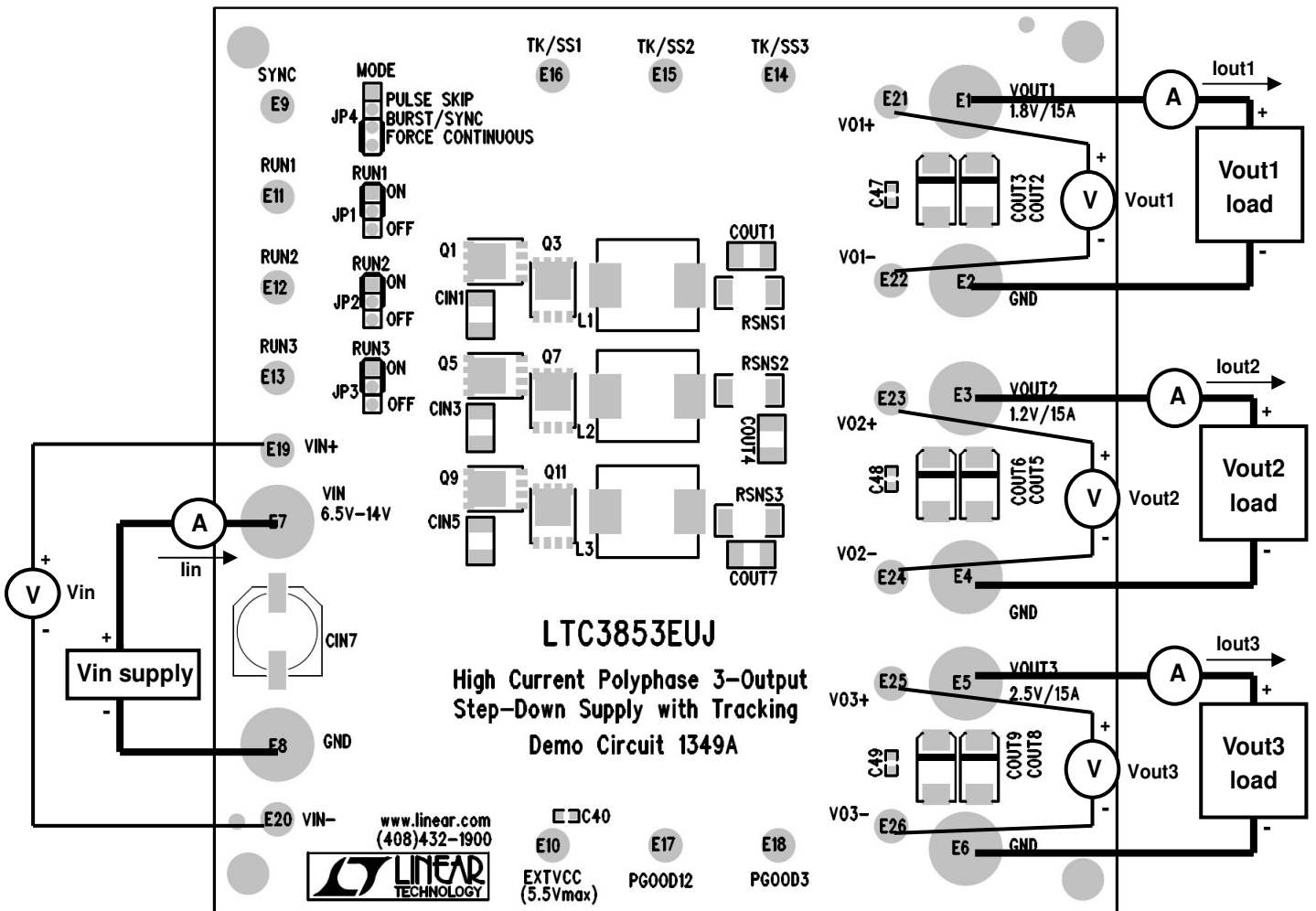


Figure 1. Proper Measurement Equipment Setup

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## HIGH CURRENT POLYPHASE 3-OUTPUT STEP-DOWN SUPPLY WITH TRACKING

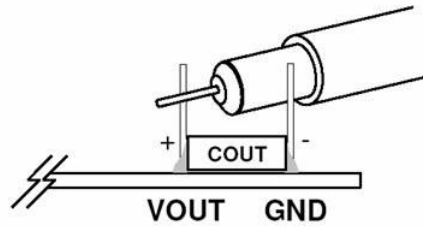


Figure 2. Measuring Input or Output Ripple Directly Across Bulk Capacitor

## RAIL TRACKING

Demonstration circuit 1349 is setup for coincident rail tracking where VOUT1 and VOUT2 track VOUT3 and the ramp-rate for VOUT3 is determined by the value of the TK/SS3 capacitor at C44 - See Figure 3. Please note that turning channel 3 off, will also turn off the other two channels, as they are tracking channel 3.

This board can be modified on the bench for external rail tracking or for independent turn-on of the rails. For the latter case, the ramp-rate for VOUT1 and VOUT2 will be determined by their respective TRK/SS capacitors. Refer to Table 2 for tracking options and to the data sheet for more details.

Table 2. Output Tracking Options

CONFIGURATION	TK/SS1 RESISTOR AND CAPACITORS			TK/SS2 RESISTOR AND CAPACITORS			TK/SS3 RESISTOR AND CAPACITORS		
	R31	R32	C46	R33	R34	C45	R35	R36	C44
Soft Start Without Tracking									
Vout1	Open	Open	10nF						
Vout2				open	Open	10nF			
Vout3 (Default)							X	Open	10nF
Vout3 equals External Ramp							0Ω	Open	Open
Ratiometric Tracking:									
Vout1 tracking Vout3	43.2kΩ	20.0kΩ	Open						
Vout2 tracking Vout3				43.2kΩ	20.0kΩ	Open			
Coincident Tracking (Default):									
Vout1 tracking Vout3	24.9kΩ	20.0kΩ	Open						
Vout2 tracking Vout3				10.0kΩ	20.0kΩ	Open			
Vout3 tracking ext. ramp							Resistor divider		Open

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## HIGH CURRENT POLYPHASE 3-OUTPUT STEP-DOWN SUPPLY WITH TRACKING

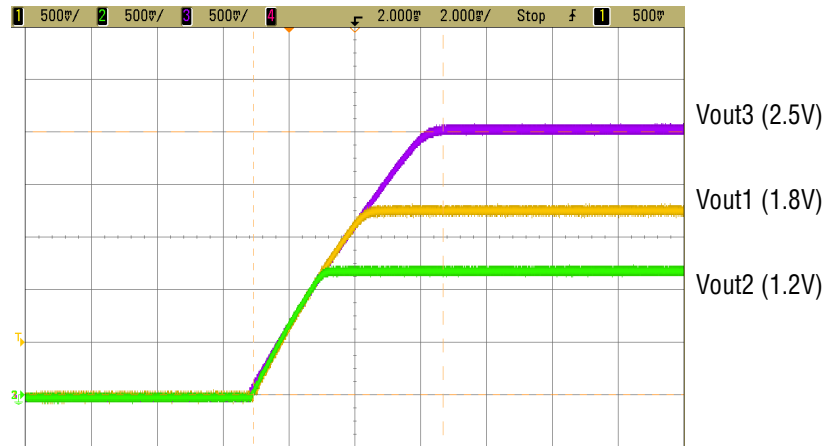


Figure 3. Default coincidental startup tracking

## FREQUENCY SYNCHRONIZATION

Demonstration circuit 1349's Mode selector allows the converter to run in CCM, pulse skip or Burst Mode operation by changing position of jumper JP4. For

synchronizing to an external clock source, however, some bench modification is needed. Refer to Table 3 and to the data sheet for more details.

Table 3. Free Running and Synchronized Operation Options

CONFIGURATION	FREQ PIN COMPONENTS			MODE SELECTOR
	R48	R65	R47	JP4
Free Running	10.0k $\Omega$	0 $\Omega$	2.55k $\Omega$	FCC, Pulse Skip or Burst Mode
Synchronized to External Clock	open	10k $\Omega$	0.01 $\mu$ F	Burst Mode or Open

## INDUCTOR DCR SENSING AND RESISTOR SENSING

The DCR sense circuit uses the resistive voltage drop across the inductor to estimate the current. In contrast to the traditional sense resistor current feedback, the DCR sensing circuit offers lower cost and higher efficiency, but results in less accurate current limit due to the large variation of the inductor DC resistance. For

modifying the demo board for DCR sensing, please refer to Table 4. A full load efficiency improvement of 1% - 2% is still possible for optional DCR sensing.

The typical efficiency versus load current for each of the outputs is given in Figures 4 to 6 respectively for a range of input voltages.

Table 4. DCR sensing component selection

	REMOVE RSENSE NETWORK	DCR NETWORK			
Vout1	R21, R22 = Open, RSNS1 = Short	R51 = 511 $\Omega$	R52 = OPEN	R53 = 0 $\Omega$	C21 = 0.47 $\mu$ F
Vout2	R23, R24 = Open, RSNS2 = Short	R52 = 402 $\Omega$	R55 = OPEN	R56 = 0 $\Omega$	C21 = 0.47 $\mu$ F
Vout3	R25, R26 = Open, RSNS3 = Short	R53 = 511 $\Omega$	R58 = OPEN	R59 = 0 $\Omega$	C21 = 0.47 $\mu$ F

### SINGLE OUTPUT / DUAL PHASE OPERATION

The demonstration circuit 1349A has been designed to support a 2+1 configuration (2 phase output plus a single phase 2<sup>nd</sup> output) as described in the LT3853 datasheet. Although the design of such a two phase output circuit is beyond the scope of the guide, some comments on how to implement this on this demo board should be mentioned.

1. Make sure the power components for ch1 and ch2 are the same (All components on right side of IC on

schematic for these two channels). Short Vout1 to Vout2 using the pads provided.

2. Remove all components connected to VFB2 (pin12) and ITH2 (pin 13). Remove feedback resistor R37.

3. Install optional components R63, R64, R66 and R68 with 0 $\Omega$  jumpers and R67 with a **100k $\Omega$  pull-up**.

4. Install the correct feedback (R1, R2 and C1) and compensation (C4, C5 and R7).

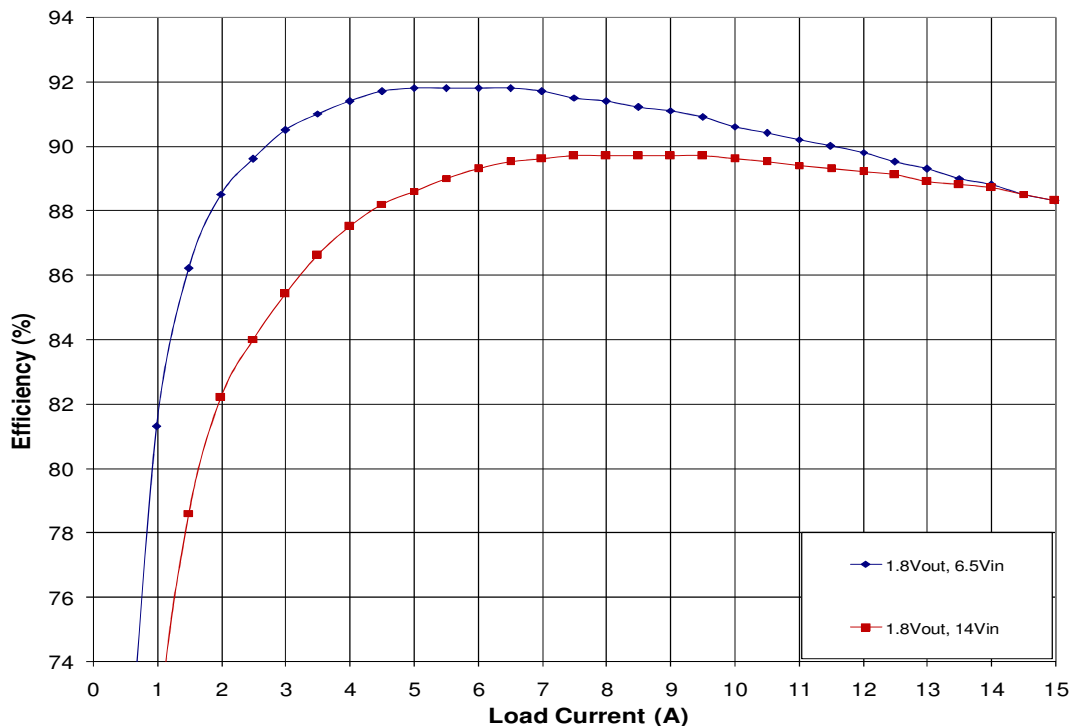


Figure 4. Typical Efficiency vs. Load Current for Vout1 (1.8V) vs. Vin

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## HIGH CURRENT POLYPHASE 3-OUTPUT STEP-DOWN SUPPLY WITH TRACKING

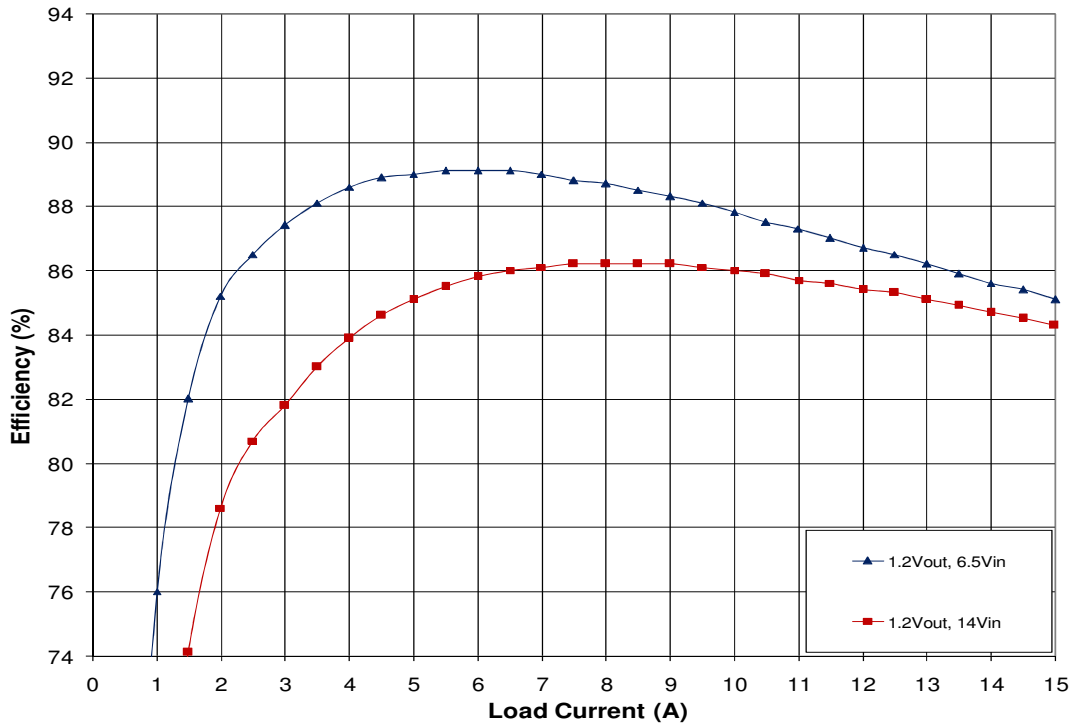


Figure 5. Typical Efficiency vs. Load Current for Vout2 (1.2V) vs. Vin

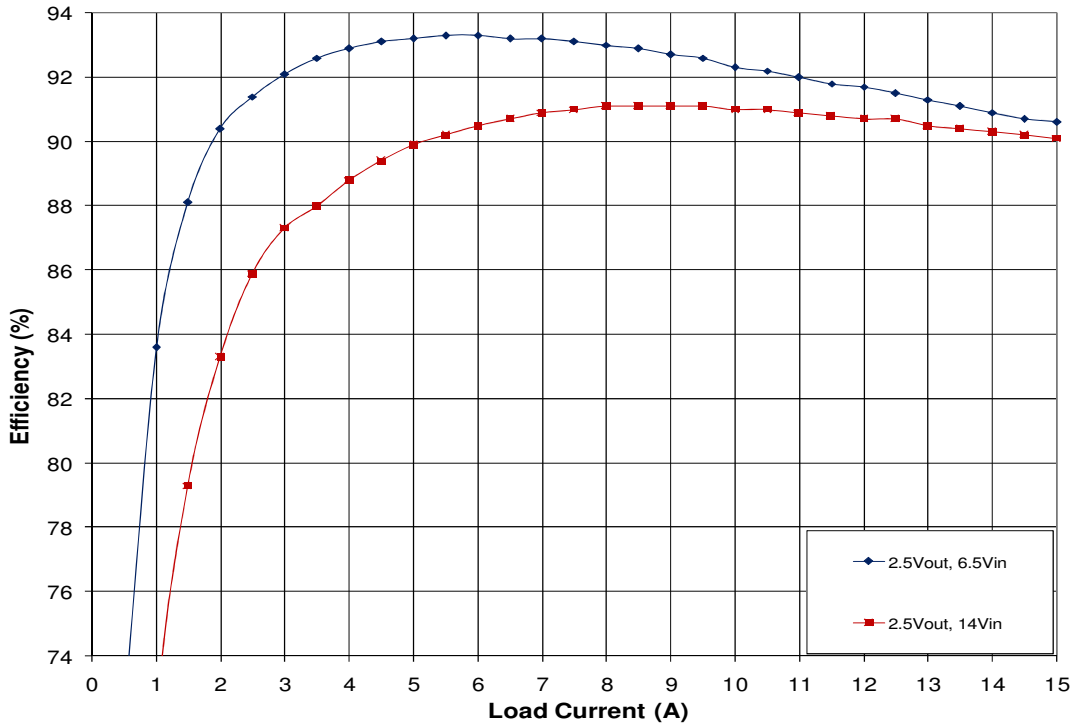
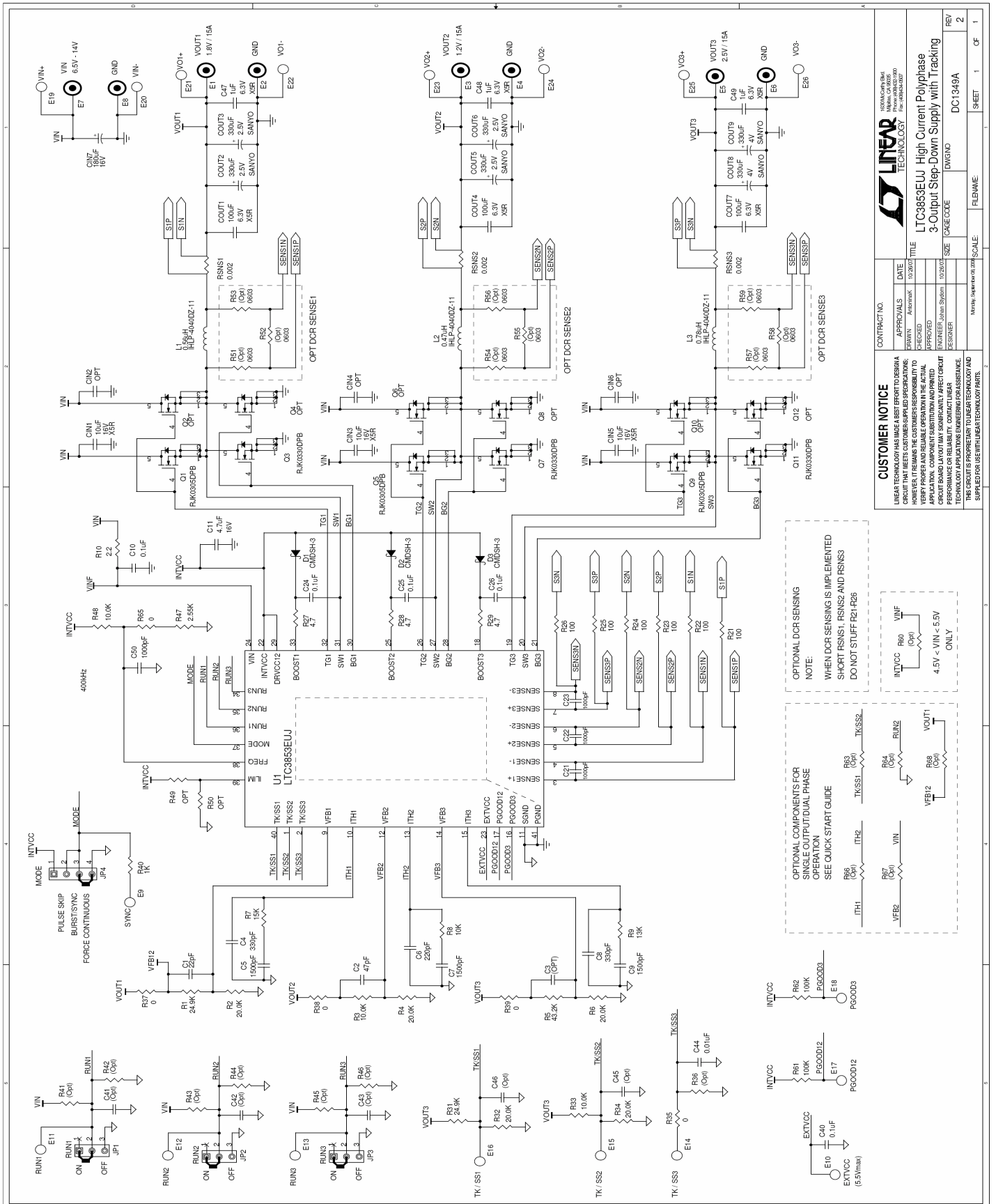


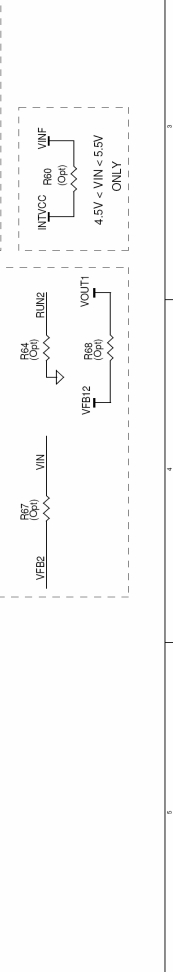
Figure 6. Typical Efficiency vs. Load Current for Vout3 (2.5V) vs. Vin

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## HIGH CURRENT POLYPHASE 3-OUTPUT STEP-DOWN SUPPLY WITH TRACKING



CONTRACT NO.		DATE		TITLE	
APPROVALS	DATE	APPROVALS	DATE	FILENAME	SCALE
DESIGNED BY	10/28/07	CHECKED BY		DC1349A	
APPROVED BY		DESIGNED BY		SHEET	1 OF 1
ENGINEER: James Symon		DESIGNER			
REV	2	DC1349A			



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